

Schuchmann, Russell P.

S/N: 10/065,688

**REMARKS**

Claims 1-20 are pending in the present application. In the Office Action mailed March 12, 2004, the Examiner rejected claims 1, 4-12, 14, 15, 18, and 19 under 35 U.S.C. §103(a) as being unpatentable over Kliman (USP 6,199,023) in view of Solomon et al. (USP 5,754,450). The Examiner next rejected claim 2, 13, 16, and 20 under 35 U.S.C. §103(a) as being unpatentable over Kliman and Solomon et al. and further in view of Cohen et al. (USP 5,930,150). Claim 3 was rejected under 35 U.S.C. §103(a) as being unpatentable over Kliman and Solomon et al. and further in view of Nystrom (USP 5,930,092). Claim 17 was indicated as allowable. Such indication is appreciated.

Claims 1, 4-12, 14, 15, 18, and 19 stand rejected under 35 U.S.C. §103(a) as being unpatentable over Kliman in view of Solomon et al. According to the Examiner, the reference "discloses a method of detecting mechanical anomalies using a motor computer readable storage medium/controller (fig. 5, #37) having a voltage sensor and a current sensor (fig. 5, #32 and #34), the controller: receives voltage and current signals from said sensors, respectively (fig. 5, i(t) and v(t) to #37), compares the instantaneous power to a model power (fig. 5, at #50), and generates a real-time spectrum analysis and determines undesirable torque conditions based on the presence of undesirable harmonics in the power signal and from the spectrum analysis (fig. 5, #56)." The Examiner recognized that Kliman "does not explicitly disclose determining a real-time power signal from the voltage and current signals and using this motor controller with a motor-driven pump." Office Action, March 12, 2004, pg. 2. As such, the Examiner further relied upon Solomon et al. for its disclosure of a "'MCSA' technique that computes a power spectrum and is used with a pump (col. 1, lines 44-50/17-20)." *Id.*, pg. 2. The Examiner then concluded that "it would have been obvious to one having ordinary skill in the art at the time of the invention that the system of Kliman could be used with motor-driven pumps and use voltage and current signals to create a power spectrum indicative of undesirable conditions, thereby providing the advantage of detecting performance problems or faults, earlier as taught by Solomon et al." *Id.*, pg. 3.

With respect to Kliman, Applicant agrees that the reference fails to teach or suggest the determining of a real-time power signal from voltage and current signals. As set forth in the Abstract, Kliman discloses "A method for removing spurious signals in a process of motor current signature analysis of an electric motor (24 or 33) [that] includes creating an electronic model of the motor, acquiring simultaneous measurements of voltage and current at the motor, applying the voltage measurements to the motor model and determining an equivalent current produced in the motor model by the applied voltage, subtracting the equivalent current from the

Schuchmann, Russell P.

S/N: 10/065,688

current measurement to produce a corrected motor current, and processing the corrected motor current through motor current signature analysis.” USP 6,199,023, Abstract. In short, Kliman teaches a motor current signature analysis technique whereby a modeled current signal derived from instantaneous voltage data is compared to an instantaneous current signal to assess operational conditions of a motor. As recognized by the Examiner, Kliman fails to teach the determination of a power signal from voltage and current data and generating a spectrum analysis of the resulting power signal.

Accordingly, the Examiner has further relied upon Solomon et al. In the Background of the Invention section of the reference, Solomon et al. states that “It is known that the characteristics of the electric current powering an electric motor which in turn operates a piece of equipment reflect the mechanical load of the equipment on the motor shaft.” Col. 1, lns. 41-44. Solomon et al. further states that, “Therefore, the current values may be analyzed with standard spectral analysis, such as by applying the discrete Fourier Transform to a demodulated current signal and computing the power spectrum of the signal.” Col. 1, lns. 44-47. As such, “one attempts to obtain a ‘current signature’ which will be different if the equipment is undergoing a change in mechanical behavior due to an incipient breakdown.” Col. 1, lns. 47-51.

From the Examiner’s statements in the March 12, 2004 Office Action as well as the excerpts referenced by the Examiner, it would appear that the Examiner has incorrectly equated the term “power spectrum” with “a spectrum of a power signal”. One skilled in the art will readily recognize that a “power spectrum” is a representation of the magnitude of the various frequency components or harmonics of a signal that has been transformed with a Fast Fourier Transform (FFT) from the temporal domain into the frequency domain. In contrast, a spectrum analysis of a power signal may or may not be a power spectrum, but as is well known, power can be defined as the product of voltage and current data. That is, a “power spectrum” is not, by definition, a spectrum of the product of voltage and current data. As set forth above, the “power spectrum” of a signal is a representation of the magnitude of frequency components or harmonics of the signal that has been transformed with an FFT from a time domain into a frequency domain.

Accordingly, the Examiner’s reliance on Solomon et al. for its teaching of a “power spectrum” as the teaching of a power signal determined from voltage and current signals cannot be sustained. In fact, Solomon et al. teaches that a discrete Fourier Transform is applied to a demodulated current signal and the power spectrum of the current signal is computed. Col. 1, lns. 47-48. As such, Solomon et al. clearly teaches that a “power spectrum” of a *current* signal – not a *power* signal – is determined. In fact, Solomon et al. further states that a “current signature” is

Schuchmann, Russell P.

S/N: 10/065,688

the goal of standard spectral analysis to determine if equipment is undergoing a change in mechanical behavior due to an insipient breakdown. Col. 1, lns. 41-51. Accordingly, Solomon et al., like Kliman, fails to teach or suggest the generation of a spectrum analysis of a power signal derived from voltage and current signals.

In short, the Examiner has failed to show, based on the art of record, that one skilled in the art, upon knowledge of that taught and/or suggested by the cited references, would have been motivated to design a motor controller for a motor-driven pump configured to receive voltage and current signals of the pump in operation from voltage and current sensors, determine the power signal from the voltage and signals, generate a real-time spectrum analysis of the power signal, and determine undesirable torque conditions in the pump from the aforementioned spectral analysis.

The Examiner has likewise failed to show that one skilled in the art would have been motivated to design a computer readable storage medium having stored thereon a computer program to detect signal mechanical anomalies in a motor-driven centrifugal pump and that when executed by a processor causes the processor to determine an instantaneous pump motor signal from voltage and current data collected by one or more voltage and current sensors in a motor starter of the motor-driven centrifugal pump, signal process the instantaneous pump motor power signal, compare the processed instantaneous pump motor power signal to a pump motor power signal modeled during healthy operation of the pump motor, and if the process instantaneous pump motor signal exceeds a threshold, provide an external notification signaling mechanical anomalies in the pump.

The Examiner has similarly failed to show that one skilled in the art would have been motivated to develop a method of detecting mechanical anomalies in an operating centrifugal pump motor that includes the steps of capturing an operational model of a centrifugal pump motor assembly known to be operating normally, generating a baseline power signal from the modeling, acquiring instantaneous voltage and current signals of the pump motor assembly from voltage and current sensors in the motor assembly, determining a real-time power signal from instantaneous voltage and current, and determining a desirable harmonics in the real-time power signal based on a comparison with the baseline power signal.

Additionally, the Examiner has failed to show that one skilled in the art would have been motivated to design an apparatus for detecting undesirable torsional/mechanical conditions in a pump whereby the apparatus includes at least one voltage sensor and at least one current sensor, a processor to receive data from the at least one voltage sensor in the at least one current sensor,

Schuchmann, Russell P.

S/N: 10/065,688

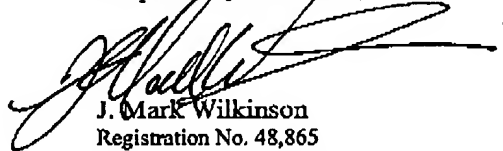
wherein the processor has means for determining a power signal from the voltage and current data, means for generating a spectrum analysis of the power signal, means for comparing the spectrum analysis to a spectrum analysis of a modeled power signal, and means for determining undesirable harmonics indicative of mechanical disturbances in the pump from the comparison.

Regarding the rejection of claims 2, 3, 13, 16, and 20, Applicant respectfully believes that these claims depend from what is believed an otherwise allowable claim and, while Applicant disagrees with the Examiner with respect to the art as applied, Applicant does not believe additional remarks are necessary and therefore requests allowance of claims 2, 3, 13, 16, and 20 based on the chain of dependency.

Therefore, in light of at least the foregoing, Applicant respectfully believes that the present application is in condition for allowance. As a result, Applicant respectfully requests timely issuance of a Notice of Allowance for claims 1-20.

Applicant appreciates the Examiner's consideration of these Remarks and cordially invites the Examiner to call the undersigned, should the Examiner consider any matters unresolved.

Respectfully submitted,



J. Mark Wilkinson  
Registration No. 48,865  
Direct Dial 262-376-5016  
[jmw@zpspatents.com](mailto:jmw@zpspatents.com)

Dated: 5/19/04  
Attorney Docket No.: ETC7455.050

**P.O. ADDRESS:**  
Ziolkowski Patent Solutions Group, LLC  
14135 North Cedarburg Road  
Mequon, WI 53097-1416  
262-376-5170